COMMITTEE ON THE
STATUS OF ENDANGERED
WILDLIFE IN CANADA

OTTAWA, ONT. K1A 0H3
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COMITÉ SUR LE STATUT
DES ESPÈCES MENACÉES
DE DISPARITION AU
CANADA

OTTAWA (ONT.) K1A 0H3
(819) 997-4991

STATUS REPORT ON THE ORD'S KANGAROO RAT *DIPODOMYS ORDII* IN CANADA

BY

DAVID L. GUMMER

STATUS ASSIGNED IN 1995
VULNERABLE

REASON: SPARSELY DISTRIBUTED IN SMALL SCATTERED POPULATIONS; CANADIAN POPULATIONS DISJUNCT FROM NEAREST POPULATIONS IN MONTANA; RESTRICTED TO SAND DUNE HABITATS.

OCCURRENCE: ALBERTA AND SASKATCHEWAN

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JUNE 1994

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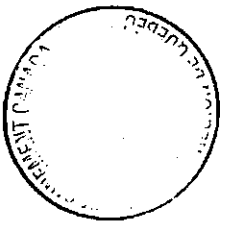

STATUS REPORT ON THE ORD'S KANGAROO RAT *DIPODOMYS ORDII* IN CANADA

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A. ABSTRACT

Ord's kangaroo rat (*Dipodomys ordii*) is a nocturnal rodent adapted to dry environments. Kangaroo rats require a firm, sparsely vegetated ground surface for burrowing and bipedal movement, and therefore they are associated with sand dune habitats. In Canada, they are found only in the sand hill areas of southern Alberta and Saskatchewan. Canadian populations of kangaroo rats are at the northern fringe of the species' range, and must cope with a more variable climate than their southern counterparts. Estimates of Canadian population sizes were made during the drought of the 1980's, and populations were considered low. Being a desert species, successful reproduction by kangaroo rats is highly correlated with moisture conditions. In the past several years, populations should have increased due to the relatively moist conditions that have prevailed.

The distribution and population size of Ord's kangaroo rat in Canada appear limited by environmental conditions and the availability of optimal habitat. The populations are reproductively isolated from the rest of the species, faced with fragmented habitat, and slowly losing habitat as open sand is encroached upon. By COSEWIC's definition, Ord's kangaroo rat is vulnerable. Population size and distribution surveys should be conducted to determine whether the species is at risk enough to be classified as threatened.

B. INTRODUCTION

Ord's kangaroo rat (*Dipodomys ordii*) is a medium sized Heteromyid rodent adapted to arid and semiarid environments (Garrison and Best 1990). It is the only member of *Dipodomys* found in Canada (Banfield 1981) and it is easily identified because of its very large hind legs and feet which facilitate bipedal locomotion (Setzer 1949). Kangaroo rats are fossorial and active on the surface only at night when collecting plant seeds (Kenagy 1976). They have external, fur-lined cheek pouches (Soper 1964) and five toes on each foot (Brown 1989). The ventral surface is white and the dorsal coloration is mostly orange-brown (Garrison and Best 1990, Banfield 1981). The species has distinct facial markings and a tufted tail that is generally longer than the head and body combined (Hall 1981, Soper 1964). In Canada, the average mass of adult kangaroo rats is 70.7 g (range = 60 to 86.5 g; Kenny 1989). Evidence of kangaroo rat presence includes obvious burrow entrances, trails, clipped vegetation, and distinct tracks on the ground. The tail drags, leaving long marks between foot tracks (Brown 1989, Epp and Waker 1980).

C. DISTRIBUTION

Ord's kangaroo rat is distributed as far south as central Mexico, and occurs in the United States between central Oregon and Oklahoma. In Canada, kangaroo rats are found only in southeastern Alberta and southwestern Saskatchewan, representing the northern fringe of the species' range (Smith 1993, Brown 1989, Banfield 1981, Hall 1981, Kennedy and Schnell 1978, Soper 1964, Hall and Kelson 1959; Fig. 1).

A more precise knowledge of the distribution of kangaroo rats in Canada is required. Existing records of kangaroo rat sightings and collection localities in Canada are shown in Fig. 2. The distribution of kangaroo rats in Canada was investigated during 1984 and 1985 and found to be almost exclusively active sand dune complexes. No evidence of kangaroo rats was found at Dinosaur Provincial Park nor at the Pakowki Lake sand dunes of Alberta (Kenny 1989). Although there are no sand dunes near Ravenscrag, SK., there is a documented kangaroo rat sighting for that area (Carleton 1956). Kangaroo rats were found occupying a right-of-way south of Bindloss, AB. (Smith and Hampson 1969), and have been observed along sand and gravel road surfaces of the proposed Suffield National Wildlife Area, AB., during nightlighting surveys (Canadian Wildlife Service unpubl. data; as in Steenhof and Sundberg 1992, 1991).

There are no documented sightings of kangaroo rats closer to the international border than Ravenscrag, SK (Carleton 1956). The sandy-soiled Milk River area in Alberta might be expected to support kangaroo rat populations (see Smith and Hampson 1969), however Soper (1964) was unable to find evidence for them there. It appears that Canadian kangaroo rats are geographically and therefore reproductively isolated from the rest of the species. It has been suggested that kangaroo rats in Canada have been isolated since the post-Wisconsinian Hypsithermal interval, approximately 5,000 years B.P. (Kenny 1989, David 1971).

The distribution of Ord's kangaroo rat in Canada appears limited by the distribution of its preferred habitat, sand dune complexes. Because these are separated by distances of

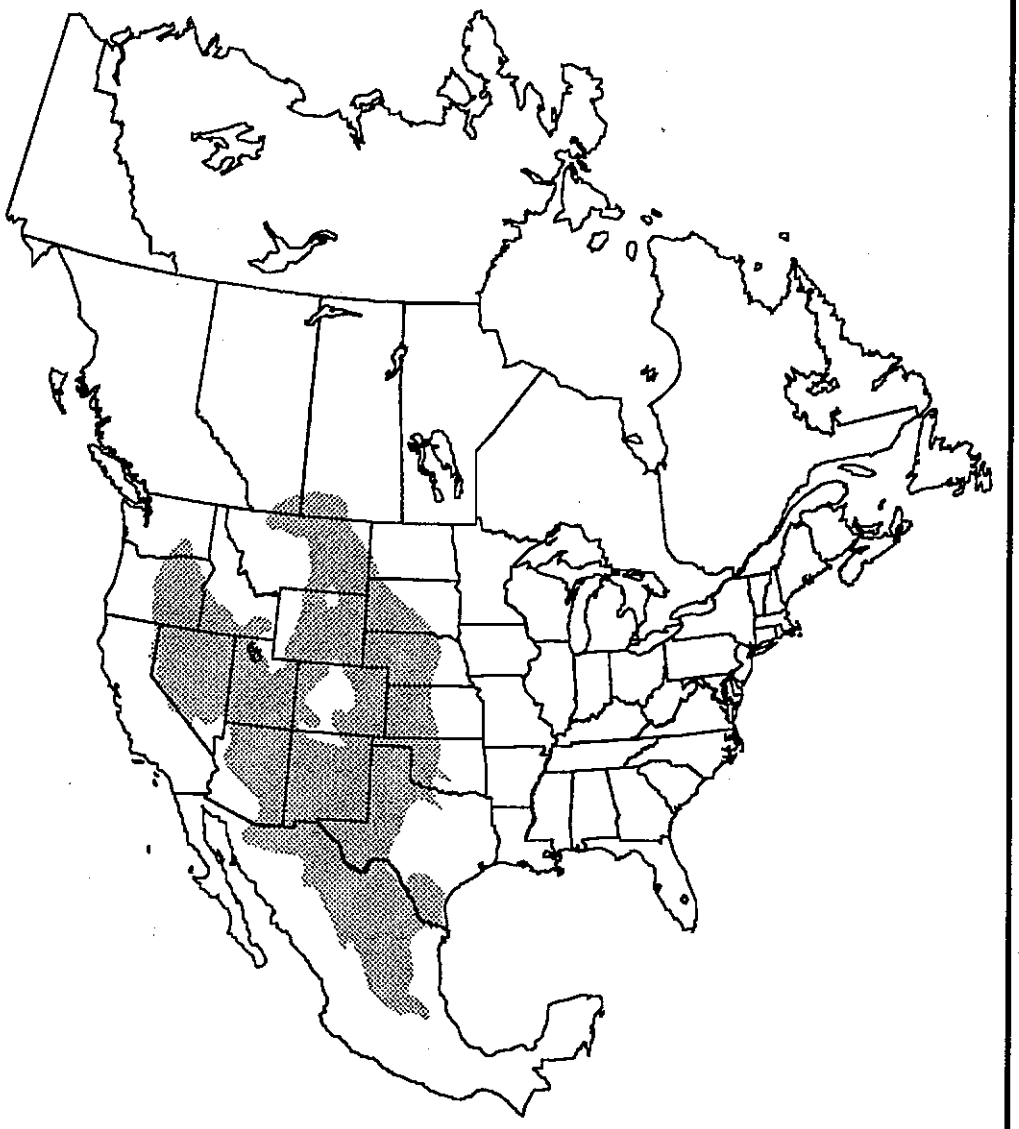

Figure 1. The North American distribution of Ord's kangaroo rat (after Hall 1981).

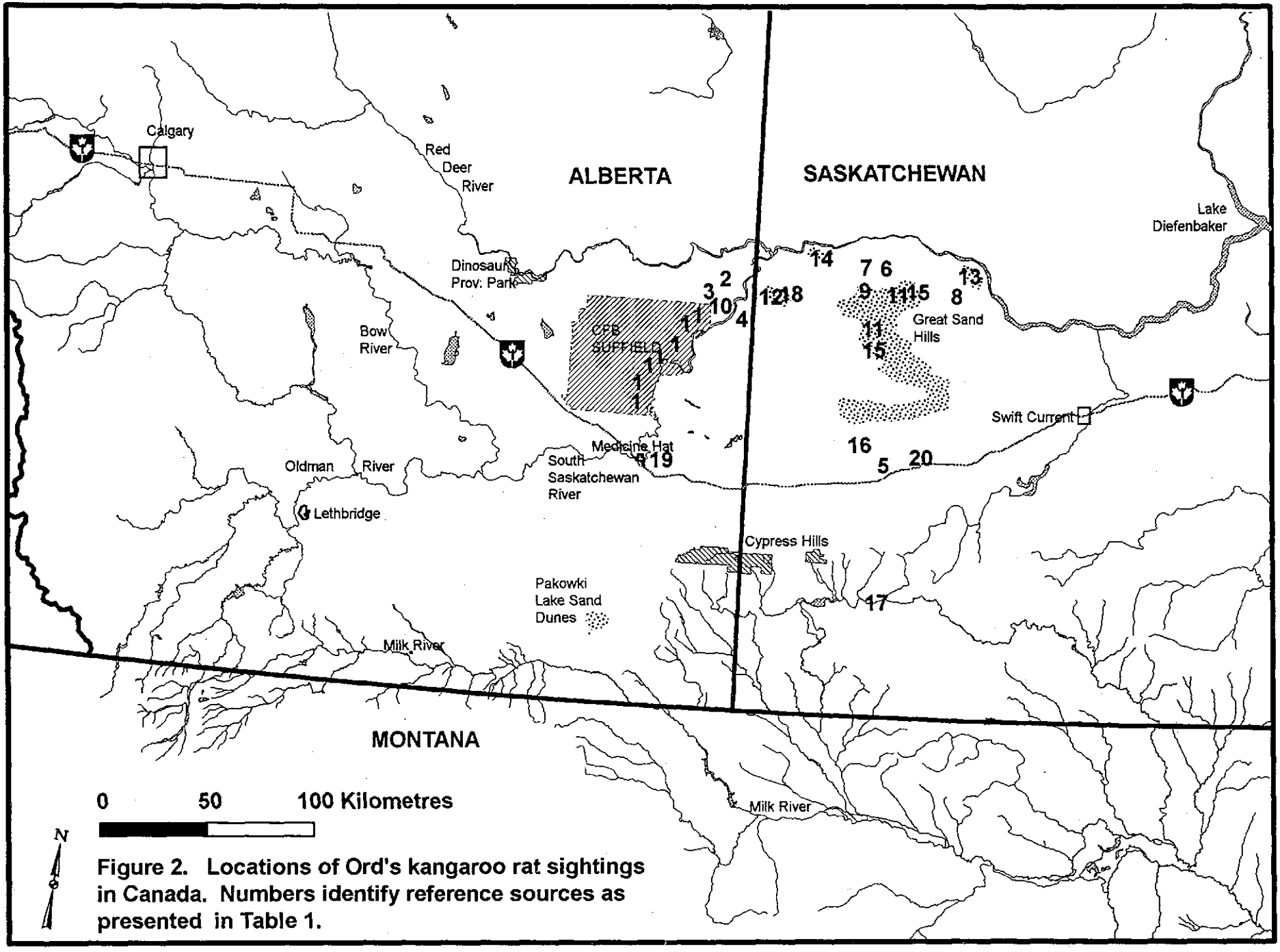

Figure 2. Locations of Ord's kangaroo rat sightings in Canada. Numbers identify reference sources as presented in Table 1.

Table 1. Collection and sighting records for Ord's kangaroo rat in Canada. The index numbers refer to geographic locations indicated on Figure 2.

Index Number	Site Description	Source Reference
1	Canadian Forces Base Suffield	(Canadian Wildlife Service unpubl. data, Stevens 1972, Reynolds and Armbruster 1971)
2	southwest of Empress	Provincial Museum of Alberta (Baron pers. comm., Smith and Hampson 1969)
3	southeast of Bindloss	Provincial Museum of Alberta (Baron pers. comm.)
4	Hilda-Empress area	Provincial Museum of Alberta (Baron pers. comm., Smith 1972)
5	Piapot	Royal Saskatchewan Museum (Baron pers. comm.)
6	Portreeve	Royal Saskatchewan Museum (Baron pers. comm.)
7	Sceptre	Royal Saskatchewan Museum (Baron pers. comm.)
8	Shackleton	Royal Saskatchewan Museum (Baron pers. comm., Nero 1956)
9	south of Sceptre	Royal Saskatchewan Museum (Baron pers. comm., Nero and Fyfe 1956)
10	Middle Sand Hills	(Kenny 1989)
11	Great Sand Hills	(Kenny 1989)
12	Burstall Hills	(Kenny 1989, Baron 1979)
13	Cramersburg Hills	(Kenny 1989)
14	Westerham Hills	(Kenny 1989)
15	Great Sand Hills	(Epp and Waker 1980)
16	near Bigstick Lake	(Epp and Waker 1980)
17	Ravenscrag	(Carleton 1956)
18	Mendham	(Nero and Fyfe 1956)
19	Medicine Hat	U.S. Biological Survey, 1931 (Anderson 1946)
20	Tompkins	(Anderson 1946)

well vegetated ground, kangaroo rat habitat can also be considered fragmented (Kenny 1989). Movement of individuals between patches of sand is presumably impaired, resulting in spatially-organized "metapopulations" (Hanski and Gilpin 1991). The persistence of metapopulations is predicted to decrease as isolation increases (Hansson 1991), and therefore the fragmented nature of kangaroo rat habitat is an important consideration.

D. PROTECTION

Kangaroo rats are listed on the Alberta Blue List, and the Saskatchewan Conservation Data Centre (SCDC) ranks Ord's kangaroo rat as "imperiled in the province because of rarity" (SCDC 1994). The Saskatchewan Critical Wildlife Habitat Protection Act (1984) protects kangaroo rat habitat by preventing the clearing and breaking of Crown lands. In the Great Sand Hills of Saskatchewan, 84% of the land is owned by the provincial government, of which 69% is leased for cattle grazing (Epp and Townley-Smith 1980). Fortunately, most sand hill environments that kangaroo rats inhabit are difficult to access. This inaccessibility has prevented intense development of these areas.

The general distribution of the species (Fig. 1) does include Grasslands National Park, Cypress Hills Interprovincial Park, and Writing on Stone Provincial Park, but occurrence of kangaroo rats in those areas has not been documented.

Canadian Forces Base Suffield (Fig. 2) includes a substantial portion of kangaroo rat habitat in Alberta (Canadian Wildlife Service unpubl. data, Stevens 1972, Reynolds and Armbruster 1971). As a result of a memorandum of understanding between Environment Canada and the Department of National Defense, the eastern-most part of the block is a proposed National Wildlife Area (454 km^2). There is restricted access, and kangaroo rats are abundant in the Middle Sand Hills portion (Canadian Wildlife Service, unpubl. data). Military training and energy exploration are managed so as to minimize impact on the landscape, flora, and fauna.

E. POPULATION SIZE AND TREND

The only reported estimates for population sizes of Canadian kangaroo rats are presented in Table 2. Unfortunately the populations whose densities were estimated represent unknown fractions of the total Canadian kangaroo rat population. The densities reported by Kenny (1989) are much lower than those reported in Texas: 15.6 indiv/ha, ranging from 9.9 to 26.9 indiv/ha (Garner 1974). Densities as high as 53 indiv/ha have been documented in other parts of the United States (Conley et al. 1977). Canadian population sizes were considered low during 1984 and 1985 because of the ongoing drought (Kenny 1989). Kangaroo rat reproduction is related to moisture conditions, being most productive after moisture has been abundant (Best and Hoditschek 1986, Hoditschek and Best 1983, McCulloch and Inglis 1961). Precipitation in the prairies during 1992, 1993, and the spring of 1994 was significantly higher than in previous years (Environment Canada). It is likely that the numbers and distribution of kangaroo rats have increased since 1985, however this

Table 2. Population estimates for kangaroo rats in Saskatchewan (Kenny 1989; Fig. 2).

Region	Population Estimate (indiv)	Confidence Limits Lower	Upper	Area Estimate (ha)	Density (indiv/ha)
Burstall Hills	81.5	73.5	90.4	37	2.2
Cramersburg Hills	55.3	49.9	61.4	24	2.3
Great Sand Hills	1233.7	992.8	1533.0	630	2.0

needs to be verified. Estimates of population sizes are required before considering management options for the conservation of this species.

F. HABITAT

Ord's kangaroo rat inhabits semiarid grassland and open scrubland environments with sandy soils (Hallett 1982, Armstrong 1979, Maxwell and Brown 1968). Because of the bipedal and fossorial nature of kangaroo rats, they prefer habitats that provide smooth, sparsely vegetated substrates with workable soils (Bartholomew and Caswell 1951). During years of high population densities, rats probably emigrate to nearby habitats that provide the next least vegetated ground. Road surfaces and intensively grazed pastures are examples of such alternative habitats (Kenny 1989). Reynolds (1958) reported an abundance of Merriam's kangaroo rats (*D. merriami*) in heavily grazed pastures of Arizona, and proposed that decreased stubble height and density of perennial grasses made the habitat more favourable for kangaroo rat locomotion and burrowing. Additionally, unvegetated corridors such as road surfaces increase the connectance of metapopulations and thus can be important for the dispersal of kangaroo rats (Price et al. 1994).

Vegetation communities associated with the presence of Ord's kangaroo rat in the United States include *Juniperus* (Allred 1973), *Artemisia* (Rogers and Hedlund 1980), *Sarcobatus* (Feldhamer 1979), *Atriplex* (Honeycutt et al. 1981), *Yucca* (Maxwell and Brown 1968), *Prosopis*, and *Quercus* (Best and Hoditschek 1986, Garner 1974, Dice 1930). Kangaroo rat occurrence in Canada appears correlated with *Psoralea* and *Rosa woodsi* (Canadian Wildlife service unpubl. data, Baron 1979, Nero and Fyfe 1956).

Sparsely vegetated sand is an important characteristic of kangaroo rat habitat; however, eroding sand slowly stabilizes as vegetation encroaches. This process is largely the result of gradual climatic change towards moister conditions, however humans enhance the process by discouraging erosion. In the past, prairie fires made the sand hills more prone to wind erosion. Fires are now suppressed and have minimal effect on the prairie (Epp and Townley-Smith 1980). Additionally, attempts are often made to halt erosion occurring along roadways and agricultural land. For example, hay bales are stacked against eroding sand and deep rooting vegetative cover increases. Therefore, the amount of habitat available to kangaroo rats is decreasing slowly. Considering the unique and restricted nature of active sand complexes in the Canadian prairies, this potential habitat loss needs to be acknowledged.

G. GENERAL BIOLOGY

Little is known about the general biology of Ord's kangaroo rat in Canada, however the species has been well studied in the United States. The Canadian population may experience more severe ecological constraints due to the cold winter climate of the Canadian prairies.

Reproductive Capability

In captivity, Ord's kangaroo rat can live as long as 7 years, 5 months. The maximum litter size and number of litters per year per female were 6 and 5, respectively. The maximum number of litters per lifetime was 9 with up to 38 young being produced in a female's lifetime (Egoscue et al. 1970).

Ord's kangaroo rat is capable of breeding approximately 83 days after birth (Jones 1985). There are generally one or two breeding seasons per year (Flake 1974, Johnston 1956), although they are capable of reproducing all year if conditions are favourable (Hoditschek and Best 1983). Female kangaroo rats appear to control the timing and frequency of breeding (Johnston 1956). Males are capable of reproduction during the entire year, whereas female reproductive activity is related to precipitation (Hoditschek and Best 1983), food availability, and population density (McCulloch and Inglis 1961). The average number of embryos per female kangaroo rat in Nevada was 3.5 (range = 1 to 6; Hall 1946), and 2.4 in New Mexico (range = 2 to 3; Johnston 1956). The number of embryos per female is correlated with rainfall during the previous month (Best and Hoditschek 1986). Gestation is 28 to 32 days (Day et al. 1956, Duke 1944), and free-ranging females often have 2 litters during the same year (Johnston 1956, Alcorn 1941). The birth rate for a New Mexico population of Ord's kangaroo rats was estimated at 235% (Johnston 1956).

Kangaroo rats breed in early spring and after midsummer rains (Daly et al. 1984, Hoditschek and Best 1983, Beatley 1976, 1969). The only study that considered reproduction by Canadian kangaroo rats reported the same periods (Kenny 1989). The number of juveniles caught in live traps in 1984 and 1985 peaked in June and August. The same study suggested that reproduction by kangaroo rats in the Great Sand Hills was less than half that documented for southern populations (Kenny 1989).

Males tend to be larger than females (Kennedy and Schnell 1978, Desha 1967), and appear to be more abundant and active as well (Garrison and Best 1990). The sex ratio of kangaroo rats caught by traps in New Mexico was 1:1 outside of the breeding season, and 1.7:1 in favour of males during the breeding season. This is likely due to pregnant or lactating females altering their activity and perhaps spending less time above ground (Johnston 1956).

Of 124 Ord's kangaroo rat specimens collected in New Mexico, 20 individuals were deemed pseudohermaphroditic males (Pfaffenberger et al. 1986). Male pseudohermaphroditism implies functional males with nonfunctional female sex organs. Bawdon (1965) reported a hermaphroditic Ord's kangaroo rat in Oregon, but did not determine whether both gametes were being produced. The evolutionary significance and distribution of pseudohermaphroditism in kangaroo rats remains unknown. *D. ordii* is the only Heteromyid for which pseudohermaphroditism has been recorded (Pfaffenberger et al. 1986, Bawdon 1965).

Behaviour and Ecology

Heteromyid rodents are territorial, each defending their burrows and the vicinity (Eisenberg 1963). They are not colonial: individuals are solitary and show little tolerance for others within the territory (Daly et al. 1984, Garner 1974, Bartholomew and Caswell 1951). Bannertail kangaroo rats (*D. spectabilis*) defend non-overlapping territories (Randall

1984), use footdrumming as a territorial signal, and will chase and attack intruders (Ward and Randall 1987). Both intra- and interspecific fighting between *Dipodomys*, sometimes resulting in death, have been observed in laboratory environments (Bartholomew and Caswell 1951).

Predators of Ord's kangaroo rat include coyotes (*Canis latrans*; Johnson and Hansen 1979a, 1979b), kit foxes (*Vulpes macrotis*; Egoscue 1956), Great Horned Owls (*Bubo virginianus*; Longland and Jenkins 1987), Long-Eared Owls (*Asio otus*; Kotler 1985, Marti 1969), Barn Owls (*Tyto alba*; Maser et al. 1980, Rickart 1972, Anderson and Long 1961, Stickel and Stickel 1948), Screech Owls (*Otus asio*), Burrowing Owls (*Speotyto cunicularia*; Brown et al. 1986, Smith and Murphy 1973), and prairie rattlesnakes (*Crotalus viridis*; Soper 1964). Other potential predators in Canada are swift foxes (*Vulpes velox*), red foxes (*V. vulpes*), badgers (*Taxidea taxus*), bobcats (*Felis rufus*), long-tailed weasels (*Mustela frenata*), Short-Eared Owls (*Asio flammeus*), and bull snakes (*Pituophis melanoleucus*). Evidence for predation on kangaroo rats in Canada is limited to observations of extensive badger digging around kangaroo rat burrows, and the remains of a kangaroo rat found inside a prairie rattlesnake on a gravel road of the proposed Suffield National Wildlife Area (Canadian Wildlife Service unpubl. data).

Where abundant, kangaroo rats probably comprise an important portion of the prey base for predators and have adapted many anti-predator strategies. The middle ear of Ord's kangaroo rat is sensitive to the acoustic frequencies of owl wing beats and striking snakes, allowing for evasive action to be taken (Webster and Webster 1975, 1971). Erratic bipedal locomotion is considered to have evolved for predator avoidance, primarily because this style of movement provides for energy efficient, hasty retreat across open surfaces to the safety of burrows (Yousef et al. 1970, Bartholomew and Caswell 1951). Bannertail kangaroo rats (*D. spectabilis*) perform footdrumming as an alarm signal for an anti-predator function (Randall and Stevens 1987). Ord's kangaroo rat may also footdrum (Brown 1989), and this is important because footdrumming alerts predatory snakes that they have been detected and causes them to leave rather than investigate (Randall and Stevens 1987). Kangaroo rats are less active in moonlight than on darker nights or in less open habitats, presumably to minimize detection by visually-orienting predators (Kaufman and Kaufman 1982, O'Farrell 1974, Rosenzweig 1974).

Ord's kangaroo rats primarily eat seeds (Garrison and Best 1990), but they also collect green vegetation (Best and Hoditschek 1982) and insects (Alcoze and Zimmerman 1973, Flake 1973, Johnson 1961). Kangaroo rats reportedly feed on cactus (*Opuntia*) seeds at Canadian Forces Base Suffield (Reynolds and Armbruster 1971). Wheatgrass (*Agropyron*), chokecherry (*Prunus*), lance-leaved psoralea (*Psoralea*), ground plum (*Astragalus*), and Russian thistle (*Salsola*) seeds were found in kangaroo rat cheek pouches on the proposed Suffield National Wildlife Area during 1994 (Canadian Wildlife Service unpubl. data).

The cheek pouches of kangaroo rats are used to collect food material so that it may be taken back to the burrow. Food may then be either cached or eaten below the ground surface. Kangaroo rats rarely eat outside the burrow (Kenagy 1973). Mean capacity of each cheek pouch varied from 2.48 cm^3 in California to 0.99 cm^3 in Arizona (Nikolai and Bramble 1983), large enough for daily energy requirements to be met with a single full cheek

pouch of seeds (Morton et al. 1980).

Other small rodents sympatric with kangaroo rats in Canada include the olive-backed pocket mouse (*Perognathus fasciatus*), northern grasshopper mouse (*Onychomys leucogaster*), deer mouse (*Peromyscus maniculatus*), western harvest mouse (*Reithrodontomys megalotis*), house mouse (*Mus musculus*), meadow jumping mouse (*Zapus hudsonicus*), meadow vole (*Microtus pennsylvanicus*), long-tailed vole (*M. longicaudus*), sagebrush vole (*Lagurus curtatus*), red-backed vole (*Clethrionomys gapperi*), northern pocket gopher (*Thomomys talpoides*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), and Richardson's ground squirrel (*S. richardsoni*; Canadian Wildlife Service unpubl. data, Smith 1993, Epp and Waker 1980), all of which occur in other parts of the species' range. Coexistence of rodent species appears possible because of seed size selection (Hutto 1978) and habitat differences (Lemen and Rosenzweig 1978, Brown and Lieberman 1973). Most competition studies have focused on competition between *Dipodomys*, which is inapplicable to Canadian populations of kangaroo rats. However, Munger and Brown (1981) showed that exclusion of *Dipodomys* resulted in increased abundance of smaller granivorous rodents but did not affect omnivorous species. In contrast, the northern grasshopper mouse can displace Ord's kangaroo rat into more open habitats with shorter vegetation (Rebar and Conley 1983), where there is greater predation risk. The implications of competition are important but likely no more significant than elsewhere in the species' range.

Ectoparasites of kangaroo rats are well documented. Many species of mites, ticks, chiggers, sucking lice, and fleas parasitize kangaroo rats (Whitaker 1994). Parasitism is most intense during warm months (Garner et al. 1976). Botfly (*Cuterebra*) parasitism has been reported for many rodent and lagomorph species in both Canada and the United States (Boonstra et al. 1980, Smith 1978a, 1978b, Miller and Getz 1969, Maurer and Skaley 1968, Dunaway et al. 1967, Goertz 1966, Clough 1965, Wecker 1962, Sealander 1961), but not for Ord's kangaroo rat. Of 79 kangaroo rats that were captured and closely examined in 1994 at the proposed Suffield National Wildlife Area, 25 (32%) were parasitized by botflies, evidenced by obvious surface wounds and sometimes emerging larvae. Some individuals had as many as four scars and had lost most of their pelage (Canadian Wildlife Service unpubl. data). Boonstra et al. (1980) found that botfly parasitism decreased survival, reproduction, and growth of Townsend's voles (*Microtus townsendii*). Similarly, botfly parasitism could be potentially detrimental to populations of kangaroo rats, but the actual effects of botflies on kangaroo rats have not yet been determined.

Ord's kangaroo rats are capable of surviving in semiarid environments because of specialization for water conservation. They can acquire most necessary water metabolically with little supplemental drinking (MacMillen and Hinds 1983). Urine can be concentrated to 4290 mOsmols/l, which is amongst the highest concentrations known to mammals (Fairbanks et al. 1983). Feeding experiments show that kangaroo rats (*D. spectabilis*) choose seeds with the highest moisture content (Frank 1988). Kangaroo rat nasal passages are convoluted thereby creating a thermal gradient favouring the condensation of water prior to loss from the body (Schmidt-Nielson et al. 1970). By being nocturnal, kangaroo rats may reduce the risk of predation by visual predators, but also importantly, they avoid high diurnal ambient temperatures and associated water loss (Mullen 1971). They spend the heat of day underground in their burrows where temperature and humidity are more stable and

favourable for water conservation. Ord's kangaroo rats often plug burrow entrances that are near the nest chamber to maintain the temperature and humidity (Nero and Fyfe 1956).

Water conservation is an important aspect of kangaroo rat survival in desert-like conditions. Equally important in the Canadian prairies is a strategy for surviving long, cold winters. For small mammals, the energy requirements associated with homeothermy can be too high to be met by feeding. Bats, ground squirrels, shrews, and some mice slow their metabolism to decrease the energy requirements of survival in cold climates. Decreased metabolic rate leads to a decrease in body temperature (Eckert 1988, Swan 1974). Torpor refers to a decrease in metabolic rate for a short period of time, lasting a few hours to a few days. In contrast, hibernation refers to extended periods of slow metabolic rate, lasting from weeks to months (Eckert 1988).

Torpor can be induced in captive kangaroo rats through extreme cold stress and food deprivation, and is associated with mass loss and often death (Breyen et al. 1973, Yousef and Dill 1971). Canadian kangaroo rats have been found torpid in traps on cold nights, and were easily warmed up and suffered no obvious ill effects (Kenny 1989). Kangaroo rats in the northern part of their range may use short bouts of torpor or hibernate during winter months in order to survive the cold (Kenny 1989, O'Farrell 1974).

In the United States, kangaroo rats appear to remain active throughout winter (Kenagy 1976, Jorgensen and Hayward 1965). O'Farrell (1974) found that kangaroo rats remain active on the ground surface when there is sparse snow cover (<40%) and ambient temperatures are greater than -11 °C. Otherwise, they retreat to their burrows and underground food caches. The mean January temperature at the Swift Current Airport, the closest meteorology station to the Great Sand Hills, is -13.9 °C. The extreme low temperature is -42.8 °C (Environment Canada). It is unknown how northern Ord's kangaroo rats survive the winters; perhaps chinooks moderate the winter conditions enough to allow for constant activity. Regardless, kangaroo rats in Canada face more extreme environmental constraints than do southern *Dipodomys*, and therefore may have evolved unique life history strategies.

H. LIMITING FACTORS

The factors which appear to limit the population size and distribution of kangaroo rats in Canada include moisture conditions and availability of appropriate habitat. Annual changes in moisture conditions cannot be managed, but to some extent vegetative encroachment on open sand dunes can. Shrub removal has proven an effective way of increasing population densities of Stephen's kangaroo rat (*D. stephensi*), an endangered species in the United States (Price et al. 1994).

In the past, prairie communities experienced frequent disturbance by fire (Epp and Townley-Smith 1980, Daubenmire 1968), which served to remove litter and above ground biomass. Because the greatest proportion of biomass is below ground in natural prairie communities, frequent burns have little adverse effect on native grass vegetation but decrease woody shrubs. Controlled burning of sand hill vegetation has been suggested for the Great Sand Hills of Saskatchewan because it would aid in destabilizing sand hills as well as

improve range quality for cattle and native ungulates (Kenny 1989). By destabilizing sand, controlled burning would increase the amount of optimal habitat available for kangaroo rats.

The physical landscape and associated biotic communities are dependent on one another. A unique combination of sand hills and prairie flora and fauna is necessary to provide Ord's kangaroo rat with appropriate habitat.

I. SPECIAL SIGNIFICANCE

Ord's kangaroo rat is the most widespread of 24 *Dipodomys* species (Hall 1981, Banfield 1981), and it has been well studied in the United States. If considered as a Canadian resource, the species is unique and limited with respect to numbers and distribution. It is also an example of a species highly specialized for survival in dry environments. Canadian populations are isolated from those in Montana, and are presumably adapted for a more variable climate. Ord's kangaroo rat warrants investigation and attention as an important species of prairie wildlife in Canada.

J. RECOMMENDATIONS/MANAGEMENT OPTIONS

Estimates of kangaroo rat population sizes are required before management options should be considered, and we need to establish the extent of the species' distribution in Canada. Surveys for kangaroo rats should include nightlighting along roadsides and open sand (Steenhof and Sundberg 1992, 1991), searching for kangaroo rat tracks and burrows (Kenny 1989, Epp and Waker 1980, Nero and Fyfe 1956), and mark-recapture studies. Satellite images and soil maps should be examined to determine potential kangaroo rat habitats, which could subsequently be visited for verification of the species' occurrence.

Potential management options for kangaroo rat habitat are controlled burning of prairie sand hills and shrub removal. A more thorough knowledge of the species' requirements in Canada will also be an important step towards conservation of Ord's kangaroo rat.

K. EVALUATION

In Canada, Ord's kangaroo rat is at the very northern edge of its range and is reproductively isolated from its southern counterparts. Its distribution is limited by its unique habitat requirements, namely sparsely vegetated sand hills. This habitat is fragmented, limited in distribution, and slowly being encroached upon. Unfortunately, there is no direct evidence of population trends. Kangaroo rats have added intrinsic value as a Canadian resource because the species is highly specialized and because Canadian populations may have recently evolved life history strategies for survival on the northern prairies. Ord's kangaroo rat is an "indigenous species of fauna ... that is particularly at risk because of ... occurrence at the fringe of its range and in restricted areas" (COSEWIC

1990), and therefore COSEWIC's classification of vulnerable is applicable. Future study must examine population trends and distribution in order to determine whether the species requires up-listing to threatened.

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